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DRAWINGS ATTACHED

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(54) NUTS IN STRIP FORM AND METHODS OF MAKING AND APPLYING SAME

(71) We, MACLEAN-FOGG LOCK NUT Co., a Corporation organized and existing under the laws of the State of Delaware United States of America, of 1000 Allanson Road, Mundelein, Illinois, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to nuts connected together in strip form and to methods of forming and applying such nuts to a panel. The invention will be described with reference to its application to pierce nuts, which are nuts used as punches to form openings for themselves in a panel to which they are to be rigidly secured.

At present, the use of pierce nuts is limited to extremely high volume applications, since the handling, selecting, orienting and feeding of individual nuts from a hopper requires a large amount of expensive tooling and set-up. Furthermore, existing systems for handling pierce nuts are highly specialized in the sense that the entire system of feeding, selecting and applying the nuts must be custom designed for each application inasmuch as the form of the panel and the location of the pierce nut on the panel vary in each instance.

The present invention provides a method of attaching nuts to a panel comprising the steps of forming the nuts as spaced parts of a strip of metal, locating the end nut of the strip in an aligned position between a plunger and a die, severing from the strip the end nut and a portion of the strip adjacent thereto, piercing the panel with the nut, and clinching the severed nut to the panel, said severing and piercing steps being performed with a single stroke of the plunger.

The present invention also provides a method of forming a plurality of flanged nuts connected together by relatively thin severable sections comprising the steps of providing a strip of metal with a laterally extending flange, perforating the strip with a series of spaced holes, forming threads in the holes, and removing metal between the holes to form transverse slots which leave a thin section of metal at the flange.

The present invention further provides a composite strip of separated, aligned, similarly oriented and like nuts, each having a threaded opening in the longitudinal and lateral mid-region thereof and flanges extending laterally from opposite sides, said nuts being adjoined by severable metallic connecting means which are flexible in the direction of a plane extending through the axes of the threaded openings and resistant to flexure in a direction lateral to the plane.

The invention will become clearer from the following detailed description upon reference to the accompanying drawings in which:

Figure 1 is a schematic diagram of the sequence of steps performed upon a strip of metal to produce a coil of connected pierce nuts;

Figure 2 is a plan view of the strip showing its progressive transformation by the steps in the method of this invention;

Figure 2a is a cross section through the strip in its original form;

Figures 3 and 4 are respectively bottom and side views of the strip of Figure 2;

Figure 5 is an enlarged side elevation in section of a fragment of the strip of Figure 2 taken along line 5—5 of Figure 2;

Figures 6 and 7 are enlarged transverse sections of the strip taken along lines 6—6 and 7—7 of Figure 4;

Figures 8, 9 and 10 are enlarged fragmentary elevations in sections of a modified form of pierce nut, the Figures showing three sequential steps in the application of such nut to a panel;

[Price 25p]

Figure 11 is a bottom view in perspective showing the steps in applying the pierce nut of Figure 2 to a panel; and

Figure 12 is a bottom view in perspective showing the steps in applying the modified form of pierce nut of Figures 8, 9 and 10 to a panel.

An important feature of this invention resides in forming pierce nuts in a punch press from strip stock having a predetermined rolled section but instead of shearing the nuts completely from the strip at the end of the forming operation, the strip is merely perforated between the nuts in such a manner as to leave a thin web of material between the nuts. The web will be durable enough to make it possible for the strip to be coiled into a roll and thereafter shipped and handled as a finished product. The rolls of pierce nuts may thus be sold and transported to customers as correctly oriented and precisely located nuts for use with a tool which feeds the nuts from the coil, one at a time to a die for further processing. The latter locates the pierce nut on a panel to which it is to be attached, severs it from the strip, pierces the panel with it and clinches the nut to the panel.

The initial rolled section may be purchased from a mill with the precise cross sectional profile and metallurgy desired, but it is also possible for the nut manufacturer to provide tooling for shaping the initial rolled section to have the cross section he desires.

Referring now to Figures 1 and 2 the material from which the pierce nuts are made is shown as a strip of steel having the desired physical characteristics and purchased in coil form from a steel mill which has rolled or otherwise produced a predetermined initial cross section in the strip. The resulting pierce nuts are each flanged on two of their opposed sides, the flanges acting as abutments when the nut is installed on a panel to resist pulling the nut through the panel. Accordingly, as shown in Figure 2*a*, the contour of the starting material is generally rectangular, as shown at 20, with flanges 21 and 22 formed on opposite sides of the rectangular section. The starting material is supplied in coil form, and when pulled from its initial coil, the strip may be somewhat bent, as shown at 23 in Figure 1. The first operation, therefore, to be performed on the strip is a straightening operation. This is shown at 24 in Figure 1, the strip straightener comprising a series of staggered rolls 25, 26 from which the strip, designated 27, is passed to a pair of feed rolls 28.

From the feed rolls, the strip 27 is advanced to a punch press at which is set up a progressive die 29, the first operation in which is a perforating operation. It is contemplated that several nuts will be formed simultaneously and accordingly three cylindrical punches 30 are provided at this station the punches creating three spaced round holes 31, 32 and 33 in the strip 27, as shown in Figure 2. The creation of holes 31, 32 and 33 is accompanied by a spreading of the material of the strip 27 laterally to form bulges 34, and 35 and 36 on both sides of strip 27.

The next operation performed by progressive die 29 is a slotting operation which not only forms the remaining two sides of the finished nuts but removes enough material from between adjacent nuts to leave only a part of each flange 21, 22 to connect adjacent nuts together. Thus, die 29 is provided with punches 37, 38 and 39 which are of elongate rectangular cross section and form slots 40, 41 and 42, respectively. It may be noted that these slots extend into the flanges 21 and 22 so that the sides 43 and 44 of a nut are completely formed, while at the same time the flanges 21 and 22 have been reduced in width to form relatively thin but durable connecting sections 45 and 46 between adjacent nuts.

The third operation performed by progressive die 29 is a side trimming operation designed to remove the bulges 34, 35 and 36 from the nuts. The side trimming punch is shown at 47 and comprises a simple straight-sided punch which shaves the material of the bulges off the sides and coins it into the flanges 21 and 22. This operation finishes off the other two straight sides 48 and 49 of the nut.

Generally accepted design practice for nuts requires that the holes be countersunk to at least the root diameter of the threads to facilitate starting the screw or bolt into the nut. A countersinking operation may be incorporated in the side trimming operation of the progressive die 29. The countersinking may be performed as a coining operation by the upper part of the trimming punch 47, this having associated pins (not shown) which enter the perforations to locate the strip correctly relative to the trimming punch and which at the same time form the countersink. Figure 5 shows the countersink 56 of one hole 33 as an example.

From die 29, the strip is moved into a tapping machine shown at 50 which may be designed to tap a plurality of holes simultaneously. Because of the lateral space required for each tapping unit, the holes tapped simultaneously may not be adjacent one another, but the first tap 51 will tap the first hole of one plural-hole unit operated on by die 29, the second tap 52 will tap the second hole of the adjacent plural-hole unit, and the third tap 53 will tap the third hole of the third adjacent plural-hole unit.

From the tapper 50 the strip 27 is coiled upon a suitable mandrel (not shown) to form a coil 54 containing a predetermined num-

ber of nuts. The coil is then severed from the strip by a cut-off die 55 and is ready for shipment to a customer who will apply the nuts individually to a panel. During the coiling process, the strip is bent at the connecting sections 45 and 46 so that the nut portion bounded by the sides 43, 44, 48 and 49 is not in any manner distorted to impair its usefulness as a fastener.

Figures 5, 6 and 7 show sections through the strip 27 after the holes have been tapped and the strip is ready for coiling. Each of the holes has threads 57 cut thereinto, so that the nut is complete with the side flanges 21 and 22 required for pierce nuts, and the connecting sections between nuts, as shown in Figure 7, are reduced to only that cross section which is determined to be necessary to permit handling the nuts as a strip. Obviously, the amount of material left in the sections 45 can be varied by appropriately lengthening or shortening the punches 37, 38 and 39 to remove more or less of the flanges 21 and 22.

Referring now to Figure 11, the manner in which the pierce nuts are applied to a panel 58 will now be described. The nuts are moved to the left, as viewed in Figure 11, in the strip form into an appropriate die which severs a nut 59 from the strip at a line shown dotted at 60 and which is merely an extension of the transverse wall 59*a* of a nut. In the same operation, the connecting segment 45 may also be removed to leave a clean wall 59*b* on the opposite side of the nut. Where the nut will be concealed in the final installation of the panel to which it is attached, the connecting segment may be left on the nut since it in no way hinders the piercing or clinching operation to be performed on the nut. The severed nut is then operated upon by a suitable punch such as that shown at 67 in Figure 8, and advanced by the punch through the panel 58 and onto an appropriate die. The die causes nut 59 to pierce panel 58 and remove therefrom a substantially rectangular slug 61 while at the same time forming in the corners of the protruding nut shaved or upset metal 62 which bears against the bottom surface of panel 58 to clinch nut 59 to the panel. It is understood that suitable locating means will be provided (not shown) for the nut 59 on panel 58.

Although this invention has been described with reference to pierce nuts which have flat sides parallel to the axis of the nut, the method is also applicable with modifications to pierce nuts which depend upon an inwardly directed movement of the panel material toward the sides of the nut for a clinching action.

One such modification is shown in Figures 8, 9 and 10 from which it may be observed that the nut is of substantially the same size and proportions and made from substantially the same strip of metal as the nut of Figures 2—7, except that the sides adjacent the flanges 63, 64 have been undercut, as shown at 65 and 66 in Figure 8. In that Figure, a suitable punch 67 and die 68 are used, the latter being adapted to move the material of the panel 69 inwardly into the undercut 65 and 66 to clinch the nut to the panel 69. Thus, die 68 has a tapered bead 70 formed on each side of an opening 71 therein upon which panel 69 initially rests.

The first stage in the operation of the die of Figure 8 is shown in Figure 9 and comprises displacing a slug 72 from the central regions of the die 68. The final operation is shown in Figure 10 and comprises displacing material 73 and 74 from the sides of the opening 75 (Figure 9) in the panel 69 inwardly of the nut into the undercuts 65 and 66.

Figure 12 shows a nut 76 on the end of a strip formed with undercut sides as it is applied to a panel 77 in accordance with the dies shown in Figures 8, 9 and 10. It may be apparent that the method of forming a strip 78 of connected undercut nuts 76 is substantially identical with that described in connection with the straight-sided nuts of Figure 2, except that the punch 47 is omitted and special grinders (not shown) or other surface shaping tools are substituted for punch 47 to remove the bulges formed in the perforating operation and to perform the undercutting operation.

It may thus be observed that by forming pierce nuts as readily severable parts of a strip, the usual nut orienting, selecting and feeding operations are completely eliminated and the handling of the nuts can be effected without the use of containers. Furthermore, in the application of the nuts to a panel from a strip, it is possible in one stroke of a press to sever a nut from a strip, pierce a panel with the nut and clinch the nut to the panel.

WHAT WE CLAIM IS:—

1. A method of attaching nuts to a panel, comprising the steps of forming the nuts as spaced parts of a strip of metal, locating the end nut of the strip in an aligned position between a plunger and a die, severing from the strip the end nut and a portion of the strip adjacent thereto, piercing the panel with the nut, and clinching the severed nut to the panel, said severing and piercing steps being performed with a single stroke of the plunger.

2. The method according to claim 1, wherein the severing, piercing and clinching steps are performed with a single stroke of a plunger.

3. The method according to claim 1 or 2, including the step of forming the nuts in a strip having laterally extending flanges,

removing transverse sections of the strip between the flanges to leave discrete nuts connected by the flanges, and the nuts being severed from the strip at the flanges.

4. A method of attaching nuts to a panel, comprising the steps of producing a strip having a series of aligned and substantially discrete nuts joined together within the lateral sectional profile of the nuts by relatively flexible metallic connecting means, locating the end nut of the strip over a die with the panel between the nut and die, severing the metallic connecting means between the end nut and the rest of the strip, piercing the panel by the application of force to the severed nut to effect the mounting thereof on the panel, and securing the nut in its mounted position on the panel.

5. The method according to claim 4, wherein the securement of the nut in its mounted positiaon on the panel is effected by the die and comprises the deformation of the panel adjacent the mounted nut.

6. The method according to claim 4, wherein the securement of the nut in its mounted position on the panel is effected by the die and comprises the deformation of segments of the nut into clamping engagement with the panel.

7. A method of forming a plurality of flanged nuts connected together by relatively thin severable sections, comprising the steps of providing a strip of metal with a laterally extending flange, perforating the strip with a series of spaced holes, forming threads in the holes, and removing metal between the holes to form transverse slots which leave a thin section of metal at the flange.

8. The method according to claim 7, including the step of providing a second flange in the strip, said flanges being disposed on opposite sides of the strip.

9. The method according to claim 8, wherein the step of removing metal between the holes to form transverse slots in the strip between adjacent holes comprises forming the slot between the first and second flanges.

10. The method according to claim 7, 8 or 9, wherein the perforation of the strip with a series of spaced holes causes the sides of the strip to move laterally, and including the step of straightening the sides of the strip after the holes have been formed.

11. The method according to claim 7, 8 or 9, including the step of straightening the strip prior to the step of forming holes therein.

12. The method according to claim 7, including the steps of forming a second flange in the strip, said flanges being disposed on the opposite sides of the strip, straightening the strip between rollers, said step of forming transverse slots in the strip comprising forming the slots between the first and second flanges and extending into the first and second flanges, straightening the sides of the strip at the flanges after the holes have been formed, forming the strip into a coil by bending the strip at the thin severable sections, and cutting off the coil from the strip.

13. A composite strip of separated, aligned, similarly oriented and like nuts, each having a threaded opening in the longitudinal and lateral mid-region thereof and flanges extending laterally from opposite sides, said nuts being adjoined by severable metallic connecting means which are flexible in the direction of a plane extending through the axes of the threaded openings and resistant to flexure in a direction lateral to the plane.

14. The strip according to claim 13, wherein the severable metallic connecting means comprises a plurality of flexible metallic connecting elements spaced apart from one another laterally of the strip and providing connections between adjacent nuts of the strip.

15. The strip according to claim 13, wherein the severable metallic connecting means comprises a plurality of spacing elements extending longitudinally of the strip between adjacent nuts at spaced positions laterally of the strip, said spacing elements being integral with the nuts of the strip and serving both to provide for flexure and to maintain spacing therebtween.

16. The strip according to claim 13, 14 or 15, wherein said severable metallic connecting means are integral with said flanges.

17. The strip according to claim 16, wherein said severable metallic connecting means are smaller in section that said flanges.

18. The strip according to claim 13, 14, 15, 16 or 17, wherein said adjoined nuts comprise a strip which is wound to form a coil with the severable metallic connecting means being bent to provide the required flexure in the strip.

19. A method of attaching nuts to a panel substantially as herein described.

20. A methods of forming flanged nuts substantially as herein described.

21. A composite strip of separate nuts constructed as herein described with particular reference to the embodiment illustrated in Figs. 2 to 4 of the accompanying drawings.

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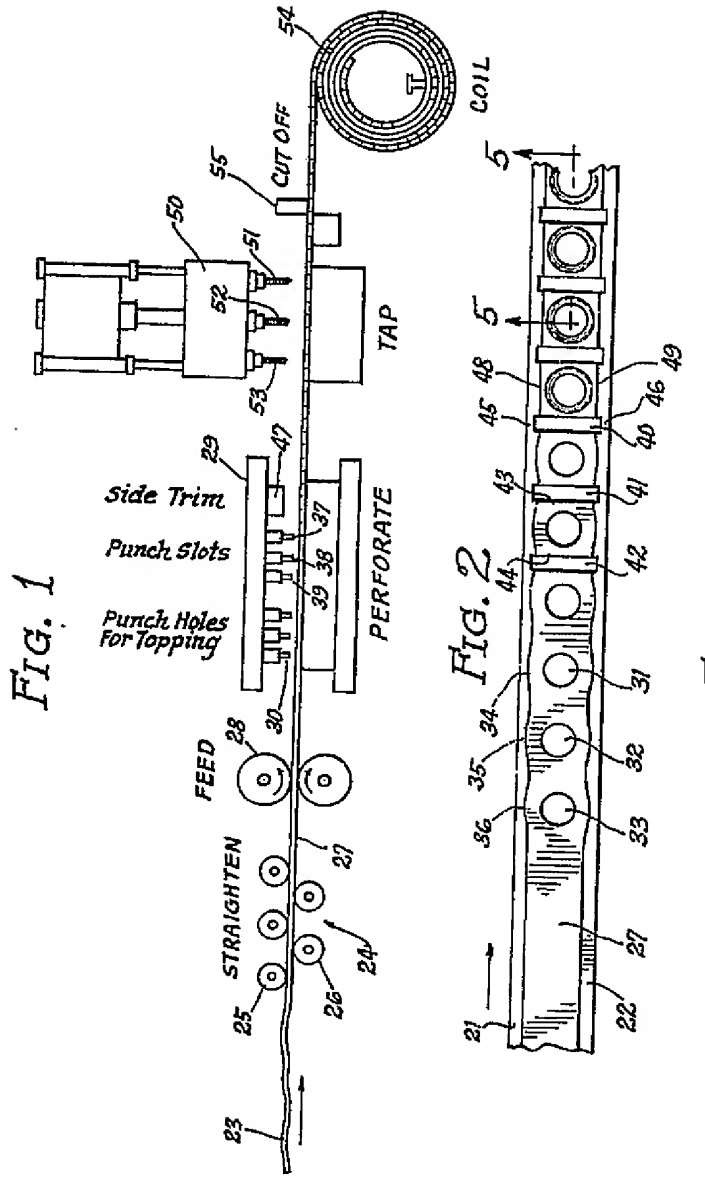


FIG. 1

FIG. 2

FIG. 2a

FIG. 3

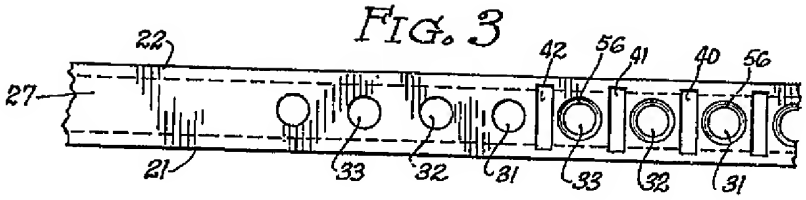


FIG. 4

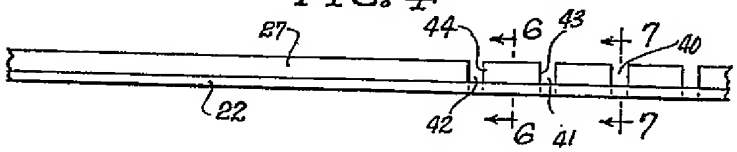


FIG. 5

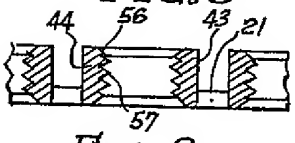


FIG. 6

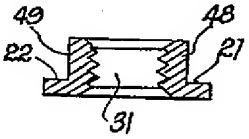


FIG. 7

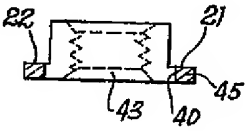


FIG. 8

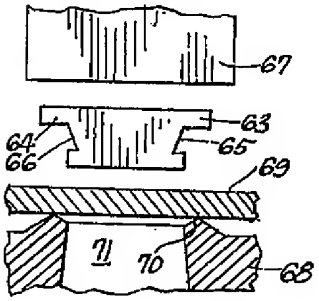


FIG. 9

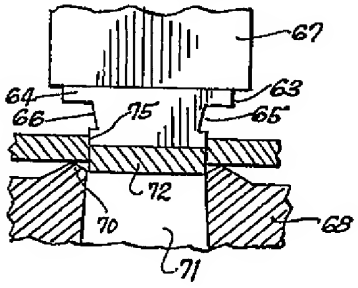
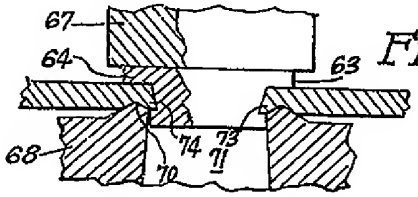


FIG. 10



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Sheet 3

FIG. 11

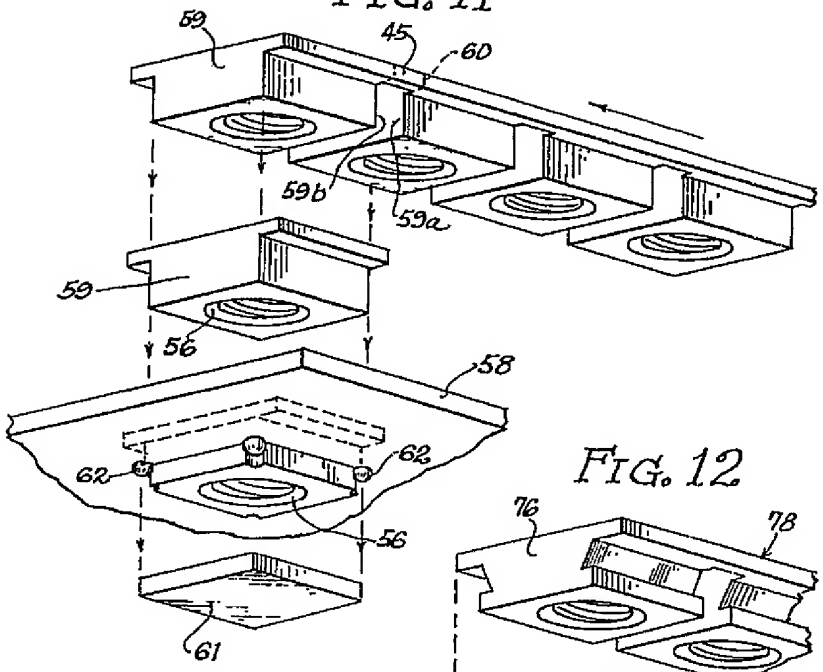

FIG. 12